

FINAL REPORT

Limited Scope Indoor Air Quality Survey
SSMC II

for

National Oceanic & Atmospheric Administration

Interagency Agreement #: D8H3CO31200
Task: NOAA 99-0-26

September 2, 2004

Prepared by:
U.S. Public Health Service
Division of Federal Occupational Health
Bethesda Central Office

Executive Summary

At the request of the National Oceanic & Atmospheric Administration (NOAA), Federal Occupational Health (FOH) collected indoor air quality measurements for temperature, relative humidity, carbon dioxide, carbon monoxide, and airborne fungal spores throughout building SSMC-2, located at 1315 East-West Highway, Silver Spring, Maryland. Measurements were taken on July 12–16, 2004 following the methodology described below.

Temperatures throughout the building over the time period ranged from 70.9 to 76.8°F. Indoor relative humidity ranged from 42.6 to 52.6 percent.

Current guidelines of the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 55-1995 (Thermal Environmental Conditions for Human Occupancy) recommend temperatures in the range of 68 to 75°F in the winter and 73 to 79°F in the summer, along with maintaining 30 to 60 percent relative humidity. These ranges are based on a dissatisfaction criterion.

Carbon dioxide measurements provide an indicator of available “fresh air” in the space. Current standards (AIHA) describe indoor carbon dioxide levels below 850 parts per million (ppm), or no greater than a 700 ppm differential between outside and inside air concentrations (ASHRAE 62-1999) as generally acceptable. Carbon dioxide measurements throughout the building ranged 436 to 667 ppm. Carbon dioxide measured outdoors ranged from 400 to 410 ppm.

Carbon monoxide measurements recorded ranged from 0 to 1 ppm. The permissible exposure limit (PEL) for CO is 50 ppm. The “Industrial Hygienist’s Guide to Indoor Air Quality Investigations” published by the American Industrial Hygiene Association, Technical Committee on Indoor Environmental Quality cites less than 9 ppm average as acceptable. There were no combustion sources in the building to cause elevated CO, and outdoor measurements were 0 ppm.

With regard to microbial sampling, indoor fungal levels were generally lower than those of outdoors and fungi detected indoors were similar to those detected outdoors.

Introduction

At the request of NOAA, FOH performed a limited scope indoor air quality investigation of Building SSMC-II, located at 1315 East-West Highway, Silver Spring, Maryland. The investigation took place on July 12–16, 2004. Evaluation methodologies and results are presented below.

Evaluation Methods

Measurements of temperature, relative humidity, carbon monoxide, and carbon dioxide were taken in eight locations on each floor of the building as indicators of relative indoor air quality using a TSI Q Trak IAQ monitor, model 8550/8551. Each floor was designated into two zones, one on each side of the elevator lobby. Four measurements were taken in each zone in randomly selected locations on the interior and exterior of the floor.

Air samples for fungal contamination were collected by a culturable method using Andersen N-6 samplers at a flow rate of 28.3 liters per minute (L/min). Indoor Andersen air samples were collected for five minutes and outdoor samples were collected for both three and five minutes. Two percent (2%) malt extract agar (MEA) was used to recover general fungi. All plates were incubated in a 25°C incubator and examined every other day for up to 10 days to ensure the full recovery of fungi. Fungal identification was based on colony morphology, spores, and conidia formation. Total fungal colonies formed on each plate were counted and recorded. Fungal levels in samples were presented as colony forming units (CFUs) per measuring unit.

Standards/Criteria

The IAQ Assessment followed general guidelines specified by the U.S. Environmental Protection Agency (EPA) "Building Air Quality" Guide for Building Owners and Facility Managers, and the "Industrial Hygienist's Guide to Indoor Air Quality Investigations" published by the American Industrial Hygiene Association, Technical Committee on Indoor Environmental Quality.

ASHRAE Standard 55-1995 (Thermal Environmental Conditions for Human Occupancy) recommends temperatures in the range of 68 to 75°F in winter and 73 to 79°F in summer. These ranges are based on a 10 percent dissatisfaction criterion. The recommended relative humidity range is 30 to 60 percent.

Carbon monoxide (CO) levels should remain <9 ppm on average ("Industrial Hygienist's Guide to Indoor Air Quality Investigations" published by the American Industrial Hygiene Association, Technical Committee on Indoor Environmental Quality). The PEL for CO is 50 ppm.

Carbon dioxide levels should remain at <850 ppm ("Industrial Hygienist's Guide to Indoor Air Quality Investigations" published by the American Industrial Hygiene Association, Technical Committee on Indoor Environmental Quality). ASHRAE 62-1999 recommends indoor carbon dioxide levels no greater than 700 ppm higher than outdoor levels (outdoor levels generally range from 300 to 500 ppm).

There are no "standards" for microbial burden. Complaint areas are generally compared with non-complaint areas and outside air.

Results and Conclusions

Temperature, relative humidity, carbon dioxide, and carbon monoxide measurements by location are tabulated in Attachment A.

Microbial results are tabulated in Attachments A and B.

Temperatures throughout the building over the time period ranged from 70.9 to 76.8°F. Indoor relative humidity ranged from 42.6 to 52.6 percent. There were temperature and relative humidity measurements that fell outside the ASHRAE guidelines. Sample locations where these measurements were collected can be found in Attachment A.

Carbon dioxide measurements provide an indicator of available “fresh air” in the space. Current standards (AIHA) describe indoor carbon dioxide levels below 850 ppm, or no greater than a 700 ppm differential between outside and inside air concentrations (ASHRAE 62-1999) as generally acceptable. Carbon dioxide measurements throughout the building ranged from 436 to 667 ppm. Carbon dioxide measured outdoors ranged from 400 to 410 ppm.

Carbon monoxide measurements ranged from 0 to 1 ppm. The PEL for CO is 50 ppm. The “Industrial Hygienist’s Guide to Indoor Air Quality Investigations” published by the American Industrial Hygiene Association, Technical Committee on Indoor Environmental Quality cites an average of less than nine as acceptable. There were no combustion sources in the building to cause elevated CO levels and outdoor measurements were 0 ppm.

With regard to microbial sampling, indoor fungal levels were generally lower than those of outdoors and fungi detected indoors were similar to those detected outdoors.

Recommendations

Based upon this limited scope investigation:

1. Ensure that the heating, ventilation, and air conditioning (HVAC) system is routinely maintained and inspected to ensure all components are operating properly and that fresh air is adequately distributed to occupied spaces.
2. Recommend routine visual inspections of the building to detect any water intrusion from outdoors or water leaks originating from indoor plumbing.

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LABORATORY REPORT #NOAA-04-IAQ-1R

Client agency: National Oceanic and Atmospheric Administration, Silver Spring, MD

POIS#/task #: D8H04CO31200 / 99-04

Sampling dates: 7/12/04 – 7/13/04

Dates of inoculation: 7/12/04 – 7/13/04

General location: Silver Spring, MD

Specific location: Building 2 (SSMC-2)

Sampling technique: Air (Andersen N-6 sampler) sampling

Medium used: Malt extract agar (MEA) for fungi

Samples submitted by: K. Muse

Date characterization completed: 7/20/04

Air Samples on MEA plates

Sample ID	Sample Date	Sampling Location	Air Volume (L)	Fungi on MEA @ 25 C
MEA-2-1-071304-01	7/13/04	1 st floor, Museum room	84.9	1. <i>Cladosporium</i> (10*) 2. <i>Aspergillus</i> sp. (2) 3. <i>Alternaria</i> (1) 4. <i>Aureobasidium</i> (1) 5. <i>Penicillium</i> (1) 6. <i>Syncephalastrum</i> (1) 7. Basidiomycetes (6) 8. yeast (4) $\text{CFU/m}^3 = 318^{**}$
MEA-2-1-071304-02	7/13/04	1 st floor, Security station	84.9	1. <i>Cladosporium</i> (7) 2. <i>Alternaria</i> (1) 3. <i>Aspergillus niger</i> (1) 4. <i>Penicillium</i> (1) 5. Basidiomycetes (7) 6. yeast (5) $\text{CFU/m}^3 = 271$
MEA-2-1-071304-03	7/13/04	1 st floor, Lobby bathroom	84.9	1. <i>Cladosporium</i> (6) 2. yeast (3) $\text{CFU/m}^3 = 106$

MEA-2-1-071304-04	7/13/04	1 st floor, Lobby near elevators	84.9	1. <i>Cladosporium</i> (11) 2. <i>Penicillium</i> (2) 3. <i>Epicoccum</i> (1) 4. <i>Trichoderma</i> (1) 5. Basidiomycetes (17) 6. yeast (9) $CFU/m^3 = 506$
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Sample ID	Sample Date	Sampling Location	Air Volume (L)	Fungi on MEA @ 25 C
MEA-2-out-071304-04	7/13/04	Ground floor, Outside Building 2	84.9	1. <i>Cladosporium</i> (16) 2. <i>Penicillium</i> (4) 3. <i>Alternaria</i> (1) 4. <i>Aspergillus</i> sp. (1) 5. <i>Epicoccum</i> (1) 6. <i>Neurospora</i> (1) 7. <i>Nigrospora</i> (1) 8. Ascomycetes (1) 9. Basidiomycetes (44) 10. yeast (33) $CFU/m^3 = 1,402$
MEA-2-071304-01	7/13/04	2 nd floor, Cafeteria/vending machine	84.9	1. <i>Aspergillus</i> sp. (2) 2. <i>Cladosporium</i> (1) 3. Basidiomycetes (3) $CFU/m^3 = 71$
MEA-2-071304-02	7/13/04	2 nd floor, Near men's & women's bathroom	84.9	1. <i>Cladosporium</i> (10) 2. <i>Alternaria</i> (1) 3. <i>Nigrospora</i> (1) 4. <i>Penicillium</i> (1) 5. Basidiomycetes (6) 6. yeast (5) $CFU/m^3 = 294$

MEA-2- 2- 071304- 03	7/13/04	2 nd floor, Left rear hallway	84.9	1. <i>Cladosporium</i> (12) 2. <i>Alternaria</i> (7) 3. <i>Penicillium</i> (3) 4. <i>Pithomyces</i> (1) 5. Basidiomycetes (13) 6. yeast (13) $CFU/m^3 = 612$
MEA-2- 2- 071304- 04	7/13/04	2 nd floor, Near 2EL1 / at doorway	84.9	1. <i>Cladosporium</i> (4) 2. <i>Aureobasidium</i> (1) 3. <i>Penicillium</i> (1) $CFU/m^3 = 71$
MEA-2- 3- 071304- 01	7/13/04	3 rd floor, Adjacent to 3328	84.9	1. <i>Aspergillus</i> sp. (1) 2. <i>Cladosporium</i> (1) $CFU/m^3 = 24$
MEA-2- 3- 071304- 02	7/13/04	3 rd floor, Adjacent to entrance A	84.9	1. <i>Aureobasidium</i> (2) 2. yeast (3) $CFU/m^3 = 59$

Sample ID	Sample Date	Sampling Location	Air Volume (L)	Fungi on MEA @ 25 C
MEA-2-3-071304-03	7/13/04	3 rd floor, Entrance at E 100's	84.9	1. <i>Alternaria</i> (1) 2. <i>Aspergillus</i> sp. (1) 3. <i>Cladosporium</i> (1) $CFU/m^3 = 35$
MEA-2-3-071304-04	7/13/04	3 rd floor, Near 3416	84.9	1. <i>Penicillium</i> (2) $CFU/m^3 = 24$
MEA-2-4-071304-01	7/13/04	4 th floor, Entrance at far corner	84.9	1. <i>Cladosporium</i> (3) $CFU/m^3 = 35$
MEA-2-4-071304-02	7/13/04	4 th floor, In front 4378	84.9	1. yeast (1) $CFU/m^3 = 12$

MEA-2-4-071304-03	7/13/04	4 th floor, Entrance E 100's	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12 No fungal growth CFU/m < 12
MEA-2-4-071304-04	7/13/04	4 th floor, Entrance E 400's	84.9	
MEA-2-5-071304-01	7/13/04	5 th floor, Entrance A far corner	84.9	1. <i>Cladosporium</i> (2) 2. <i>Aspergillus</i> sp. (1) CFU/m ³ = 35
MEA-2-5-071304-02	7/13/04	5 th floor, Adjacent to 5328	84.9	1. <i>Cladosporium</i> (5) 2. <i>Alternaria</i> (1) 3. <i>Penicillium</i> (1) 4. Basidiomycetes (2) CFU/m ³ = 106
MEA-2-5-071304-03	7/13/04	5 th floor, Entrance E 100's	84.9	1. <i>Cladosporium</i> (1) 2. <i>Rhizopus</i> (1) CFU/m ³ = 24
MEA-2-5-071304-04	7/13/04	5 th floor, Entrance E 400's	84.9	1. <i>Aspergillus niger</i> (1) 2. <i>Aspergillus</i> sp. (1) 3. <i>Cladosporium</i> (1) CFU/m ³ = 35
MEA-2-6-071304-01	7/13/04	6 th floor, Entrance A	84.9	1. <i>Cladosporium</i> (4) 2. <i>Penicillium</i> (4) 3. <i>Alternaria</i> (1) 4. <i>Aspergillus</i> sp. (1) 5. Basidiomycetes (1) 6. yeast (1) CFU/m ³ = 141

MEA-2-6-071304-02	7/13/04	6 th floor, Gateway device center (E)	84.9	1. <i>Cladosporium</i> (2) 2. <i>Alternaria</i> (1) 3. <i>Aureobasidium</i> (1) 4. <i>Penicillium</i> (1) $\text{CFU/m}^3 = 59$
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Sample ID	Sample Date	Sampling Location	Air Volume (L)	Fungi on MEA @ 25 C
MEA-2-6-071304-03	7/13/04	6 th floor, Gateway device center (W)	84.9	No fungal growth CFU/m < 12
MEA-2-6-071304-04	7/13/04	6 th floor, Entrance B2	84.9	No fungal growth CFU/m < 12
MEA-2-7-071304-01	7/13/04	7 th floor, Entrance A	84.9	1. <i>Aspergillus</i> sp. (1) 2. <i>Penicillium</i> (1) $\text{CFU/m}^3 = 24$
MEA-2-7-071304-02	7/13/04	7 th floor, At D1 entrance	84.9	1. <i>Penicillium</i> (2) 2. <i>Aspergillus</i> sp. (1) 3. <i>Cladosporium</i> (1) $\text{CFU/m}^3 = 47$
MEA-2-7-071304-03	7/13/04	7 th floor, Entrance E 100's	84.9	1. <i>Penicillium</i> (2) 2. <i>Cladosporium</i> (1) $\text{CFU/m}^3 = 35$
MEA-2-7-071304-04	7/13/04	7 th floor, Entrance E 400's	84.9	1. <i>Cladosporium</i> (1) 2. Basidiomycetes (1) $\text{CFU/m}^3 = 24$
MEA-2-8-071304-01	7/13/04	8 th floor, Entrance A	84.9	1. <i>Penicillium</i> (1) $\text{CFU/m}^3 = 12$

MEA-2-8-071304-02	7/13/04	8 th floor, Across from 8318	84.9	No fungal growth CFU/m ³ < 12
MEA-2-8-071304-03	7/13/04	8 th floor, Entrance E	84.9	1. <i>Cladosporium</i> (1) 2. <i>Penicillium</i> (1) CFU/m ³ = 24
MEA-2-8-071304-04	7/13/04	8 th floor, At room 8415	84.9	No fungal growth CFU/m ³ < 12
MEA-2-9-071304-01	7/13/04	9 th floor, Entrance A	84.9	1. <i>Paecilomyces</i> (1) 2. yeast (1) CFU/m ³ = 24
MEA-2-9-071304-02	7/13/04	9 th floor, Health Unit	84.9	No fungal growth CFU/m ³ < 12
MEA-2-9-071304-03	7/13/04	9 th floor, Entrance E 100's	84.9	No fungal growth CFU/m ³ < 12
MEA-2-9-071304-04	7/13/04	9 th floor, Entrance E 400's	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12
MEA-2-10-071304-01	7/13/04	10 th floor, Entrance A	84.9	No fungal growth CFU/m ³ < 12
MEA-2-10-071304-02	7/13/04	10 th floor, At 10347 – entrance B	84.9	1. <i>Cladosporium</i> (2) CFU/m ³ = 24

Sample ID	Sample Date	Sampling Location	Air Volume (L)	Fungi on MEA @ 25 C
MEA-2-10-071304-03	7/13/04	10 th floor, Entrance E 100's	84.9	No fungal growth CFU/m ³ < 12
MEA-2-10-071304-04	7/13/04	10 th floor, Entrance E 400's	84.9	No fungal growth CFU/m ³ < 12
MEA-2-11-071304-01	7/13/04	11 th floor, Entrance A	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12

MEA-2-11-071304-02	7/13/04	11 th floor, Adjacent 11345	84.9	No fungal growth CFU/m < 12
MEA-2-11-071304-03	7/13/04	11 th floor, Entrance E 100's	84.9	No fungal growth CFU/m < 12
MEA-2-11-071304-04	7/13/04	11 th floor, Entrance E 400's	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12
MEA-2-12-071304-01	7/13/04	12 th floor, Hallway near entrance A	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12
MEA-2-12-071304-02	7/13/04	12 th floor, Across 12320	84.9	No fungal growth CFU/m < 12
MEA-2-12-071304-03	7/13/04	12 th floor, Hallway 12100 - 12540	84.9	No fungal growth CFU/m < 12
MEA-2-12-071304-04	7/13/04	12 th floor, Near hallway 12416 - 12470	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12
MEA-2-13-071304-01	7/13/04	13 th floor, Entrance A	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12
MEA-2-13-071304-02	7/13/04	13 th floor, Outside 13316	84.9	1. <i>Alternaria</i> (1) CFU/m ³ = 12
MEA-2-13-071304-03	7/13/04	13 th floor, Entrance E 100's	84.9	No fungal growth CFU/m < 12
MEA-2-13-071304-04	7/13/04	13 th floor, Entrance E 400's	84.9	1. yeast (1) CFU/m ³ = 12
MEA-2-14-071304-01	7/13/04	14 th floor, Entrance B hallway	84.9	No fungal growth CFU/m < 12
MEA-2-14-071304-02	7/13/04	14 th floor, Outside entrance C2	84.9	No fungal growth CFU/m < 12
MEA-2-14-071304-03	7/13/04	14 th floor, Entrance E, near 14104	84.9	1. <i>Penicillium</i> (1) CFU/m ³ = 12

MEA-2-14-071304-04	7/13/04	14 th floor, Entrance E, near 14415	84.9	No fungal growth CFU/m < 12
MEA-2-15-071304-01	7/13/04	15 th floor, Entrance A hallway	84.9	No fungal growth CFU/m < 12
MEA-2-15-071304-02	7/13/04	15 th floor, Adjacent to 15307	84.9	No fungal growth CFU/m < 12

Sample ID	Sample Date	Sampling Location	Air Volume (L)	Fungi on MEA @ 25 C
MEA-2-15-071304-03	7/13/04	15 th floor, Hallway entrance E, 100's	84.9	1. <i>Cladosporium</i> (1) 2. <i>Penicillium</i> (1) CFU/m ³ = 24
MEA-2-15-071304-04	7/13/04	15 th floor, Outside 15419 entrance E	84.9	1. <i>Penicillium</i> (1) CFU/m ³ = 12
MEA-2-16-071304-01	7/13/04	16 th floor, Hallway entrance 116E17	84.9	1. <i>Alternaria</i> (1) 2. <i>Cladosporium</i> (1) CFU/m ³ = 24
MEA-2-16-071304-02	7/13/04	16 th floor, Outside 16354	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12
MEA-2-16-071304-03	7/13/04	16 th floor, Entrance E, 100's	84.9	1. <i>Cladosporium</i> (1) CFU/m ³ = 12
MEA-2-16-071304-04	7/13/04	16 th floor, Entrance E, 16413	84.9	No fungal growth CFU/m < 12
MEA-2-17-071304-01	7/13/04	17 th floor, Entrance A / outside hallway	84.9	No fungal growth CFU/m < 12
MEA-2-17-071304-02	7/13/04	17 th floor, Outside 17352	84.9	No fungal growth CFU/m < 12
MEA-2-17-071304-03	7/13/04	17 th floor, Entrance E, 100's	84.9	No fungal growth CFU/m < 12

MEA-2-17-071304-04	7/13/04	17 th floor, Outside 17347	84.9	No fungal growth CFU/m ³ < 12
MEA-2-18-071304-01	7/13/04	18 th floor, Entrance A, 18352	84.9	1. <i>Chaetomium</i> (1)
MEA-2-18-071304-02	7/13/04	18 th floor, Entrance A, hallway	84.9	CFU/m ³ = 12 No fungal growth CFU/m ³ < 12
MEA-2-18-071304-03	7/13/04	18 th floor, Entrance E, 18416 – 18470	84.9	No fungal growth CFU/m ³ < 12
MEA-2-18-071304-04	7/13/04	18 th floor, Entrance E, 18100 – 18154	84.9	No fungal growth CFU/m ³ < 12

* Colony counts.

** Corrected particle counts were used for calculation of colony forming unit per cubic meter of air.

